

Illustrated list of additions to the ichthyofauna of the Caura River, Venezuela

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ABSTRACT: Twenty nine species have been added to the annotated checklists of the ichthyofauna of the Caura River Basin, Guiana Shield, Venezuela. Of these, 18 were found in two floodplain lagoons in the lower Caura, corresponding to the orders Characiformes, Clupeiformes, Gymnotiformes, Siluriformes and Perciformes and one species of Tetraodontiformes in the port of Maripa. The others 11 species were found in the upper Caura, representing the orders Characiformes, Gymnotiformes and Siluriformes. Previous ichthyofaunal surveys in the Caura river Basin recorded a total of 514 species, including 150 species for the upper Caura and 492 for the lower Caura. After our recent survey the total number of fish species in the whole drainage basin increased to 543 species, of which 172 and 510 belong to the upper and lower Caura, respectively.

INTRODUCTION

The Caura River Basin is one of the largest drainages basins of Venezuela, with 6,632,186 ha. It is located in the Guayana Shield, in Southern Venezuela, within the geographic coordinates 03°53'34" N, 08°04'14" N and 63°22'35" W, 65°59'41" W. The Caura River originates in the highlands of the Guayana Shield and flows through alluvial plains into the Orinoco River. This basin covers a variety of environments, some of which have been declared protected areas by the Venezuelan State, such as the Natural Monuments Cerros Ichúm – Guanococo and Sierra Maigualida, the National Park Jaua Sarisariñama and the Forest Reserve El Caura.

Machado – Allison *et al.* (2003a) divide the basin in three physiographically distinct sections: the lower Caura, from the confluence of the rivers Caura and Orinoco to the "Salto Pará"; the middle Caura, from Salto Pará to the confluence with the Merewari and Waña Rivers, and the upper Caura, from the last point to the headwaters in the Vasade Mountain. Nonetheless, in this survey we refer to the entire zone above the waterfalls "Salto Pará" as "Upper Caura" and the area below the waterfalls as "Lower Caura", since we were unable to survey the physiographic Upper Caura due to logistics. The previous authors consider that the ichthyological diversity is still not well known in this basin, in spite of the great diversity reported. Ichthyological studies in this drainage basin include those of Balbas and Taphorn (1996) who reported 135 species, afterwards the works of Machado – Allison *et al.* (1999) increased the total to 191 species for the basin and later Rodriguez-Olarte *et al.* (2003) and Lasso *et al.* (2003), indicated a total of 441 species for the whole drainage basin, with 433 species in the lower Caura and 58 in the upper zone. Almost at the same time, Machado – Allison *et al.*, (2003a, b) and Chernoff *et al.* (2003) in the RAP

Bulletin of Biological Assessment N° 28, reported 278 species (103 in the upper Caura and 226 in the lower Caura), from which they identified 110 species as new records for the Caura river. Nevertheless, in the checklist of species reported in the works of Rodriguez-Olarte *et al.* (2003) and Lasso *et al.* (2003), corresponding to surveys carried out during years 1996 to 1999, they reported 27 of these 110 new records of species listed in the RAP. With this revision it could be said then that in the RAP they achieved, at least, 73 new records of species for the whole Caura basin, increasing the checklist of 441 to 514 species. In addition, of the 103 species reported in the RAP for the upper Caura, 92 corresponded new records, increasing to 150 species, 28 of which are new records for the whole basin and 64 are species known to be present in the lower Caura too. In the lower Caura, of the 226 species reported in the RAP, 59 corresponded new records increasing to 492 species in this zone. This brief paper is to complement the checklist of species for the Caura Basin with 29 new records, extending their current distribution too.

MATERIALS AND METHODS

The survey was conducted from May 2008 through September 2009 in two sections of the basin: the upper and the lower Caura. In the upper Caura four sites were sampled: the Surumo stream, the confluence of the Erebató River and the Caura River, Kushime River (last five kilometers until the confluence with Erebató) and Ka'kada River (affluent of the Erebató River). In the Ka'kada River, the sampling was performed from the confluence of the Shimada River to the confluence of the Ka'kada with the Erebató, including three affluent streams (Suajaditu, Kajioco y Amana). In the lower Caura, three sites were sampled: in the port of Maripa, where the species *Colomesus asellus* (Müller and Troschel, 1849) (Figure 8E)

was collected, and two floodplain lagoons denominated Aricagua and Paramuto (Georeferenced in Table 1 and Figure 1). Specimens were collected with three different types of nets: hand nets, 1 mm-mesh seine nets and gill nets. All specimens collected with 1 mm-mesh seine nets and hand nets were preserved directly in formalin and some of the specimens collected with gill nets. Fishes were collected with permission of the INSOPESCA ("Instituto Socialista de Pesca y Acuicultura". Permiso N° 183532/2008-09). Later, specimens were taken to the Fish Ecology Laboratory of the "Estación de Investigaciones Hidrobiológicas de Guayana" (EDIHG), where they were identified at the species level, labeled and deposited in the Fish Reference Collection of the same institution (Institutional code: CI-EDIHG; catalog numbers: 6467 to 8122), registered in the "Registro Nacional de Colecciones Biológicas" of the "Ministerio del Ambiente" (MINAMB), with the number 030. Photographs of each of the new records were taken of the fresh and ethanol-preserved samples from collections obtained through this survey.

RESULTS AND DISCUSSION

A total of 229 fish species were collected in the two sections of basin, 84 in the upper Caura and 196 in the lower Caura (195 in the floodplain lagoons Aricagua and Paramuto). Figures 2-8 present some of the collected species. From this assemblage, 29 species constituted new records for the whole drainage, 11 species in the upper section and 18 in the lower section. Some of species in the upper section are still not fully identified, these include new records of genera and some genera with morphotypes and/or coloration pattern yet not known. Also, in the upper section were found 11 species known to be present in the lower Caura, which adds a total of 22 species for this section, which were represented by 14 Characiformes, 2 Gymnotiformes and 6 Siluriformes. The new reported species in the lower Caura were represented by 10 Characiformes, 3 Clupeiformes, 1 Gymnotiformes, 1 Siluriformes, 2 Perciformes and one member of the order Tetraodontiformes (see Table 3). The present survey is also contributing with a new report for the Orinoco drainage basin, being the species *Tyttobrycon xerui* (Figure 5B) detected in the section lower of the Caura River.

With this survey the total fish species in the Caura Basin is increased from 514 species to 543. In the upper Caura the number of species increased to 172 and in the lower Caura to 510 species, which is evidence of the great biological diversity in the drainage basin. With respect to the obvious differences in species richness between the upper and the lower sections, Machado-Allison *et al.* (2003b), Chernoff *et al.* (2003) y Lasso *et al.* (2003) have indicated that this might be due to the incursions of many species from the Orinoco in the lower Caura, specially towards the relatively ample floodplain near Caura's mouth which contains high habitat heterogeneity. Likewise, these authors indicate that the presence of Salto Pará, which acts as a physical barrier, prevents many migratory species from the Orinoco from ascending to the upper section. In addition, they also point out some differences in water chemistry, since waters above Salto Pará are oligotrophic, acidic and more transparent.

The ichthyofaunistic similarity between the Caura River

and others drainage basins of the Venezuelan Guayana Shield were relatively high. More of 50% of the species reported in the rivers Atabapo, Casiquiare, Cuyuní, Paragua, Suapure y Ventuari are present in the Caura River (Table 2). Of these, the Caroní river basin, including the Paragua River, shares the highest number of species with the upper Caura (Table 4). Such similarities already have been indicated by Lasso (1989), Chernoff *et al.* (1991) and Lasso *et al.* (2003), who have documented the biogeographical similarity between the Caura basin and the Caroní and other tributaries of the Venezuelan Guayana shield. Likewise, Provenzano *et al.* (1989) also found a similar pattern of distribution of some armored catfishes loricariids in the Guayana Shield. These facts have allowed these authors to indicate a close historic relationship among the ichthyofauna of the Guyana Shield basins based on the distribution of some species of fishes in the Caroní, Cuyuní, Ventuari, Essequibo and some Gran Sabana rivers. Our results are consistent with these hypotheses.

As all the authors above stated, we agree that full knowledge of fish richness and diversity is still unknown in this drainage basin, and we recommend that more efforts are necessary to conduct more surveys in the Caura Basin. According to the comparison of species richness

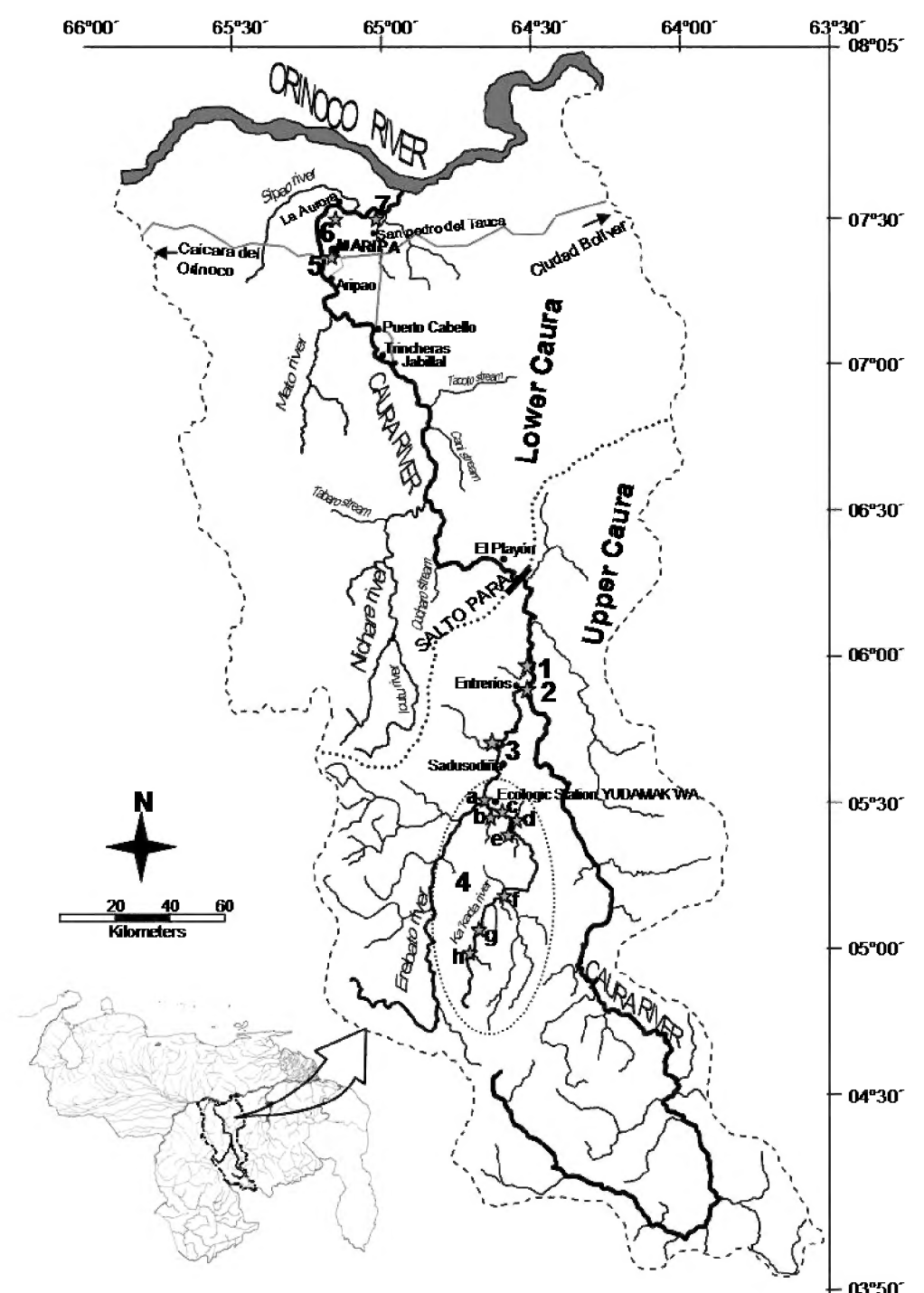


FIGURE 1. Map of the Caura River Basin, Bolívar state, Venezuela. The two sections of the basin are indicated: Upper Caura and Lower Caura. The gray stars are the sites of samplings. The numbers correspond to the localities of samplings: 1) The Surumo stream, 2) Confluence of the Erebató River with the Caura, 3) Kushime River, 4) Ka'kada River, in this the samplings were carried out from the mouth of the Shimada River until the confluence with the Erebató, including three affluent streams (Suajaditu, Kajioco y Amana), 5) Port of Maripa, 6) Aricagua lagoon and 7) Paramuto lagoon.

with other drainages, the Caura River basin represents, at the moment, the most ichthyologically diverse region of Venezuela. On the other hand, the degradation threats that this basin currently faces because of the rise of illegal mining worries us, considering that this is one of the last almost pristine regions with forests reserves in the world.

TABLE 1. General description of the sampled sites in the upper and lower sections of the Caura, Bolivar state, Venezuela.

| SITES | LOCALITY | COORDINATES | MAIN MESOHABITATS | RIPARIAN VEGETATION | MAIN SUBSTRATE | ALTITUDE (masl) |
|-------|---|--------------------------|-------------------------|--------------------------------------|---|-----------------|
| 1 | Surumo stream | 05°59'03" N, 64°25'36" W | Run | Flooded forest | Sand and litter | 249 |
| 2 | Confluence of the Eretrato River with the Caura | 05°55'46" N, 64°25'39" W | Run and riffles | Gallery forest | Rocks, sand, adhered algae and aquatic vegetation | 254 |
| 3 | Kushime River | 05°43'21" N, 64°32'54" W | Run and riffles | Gallery and flooded forest | Sand, litter and rocks | 267 |
| 4a | Kakada river, river mouth with the Eretrato River | 05°31'27" N, 64°36'19" W | Run | Gallery and flooded forest | Sand and litter | 259 |
| 4b | Kakada River, Suajaditu stream | 05°29'54" N, 64°35'15" W | Run | Flooded forest | Sand, clay and litter | 264 |
| 4c | Kakada River, main channel | 05°29'46" N, 64°34'25" W | Run and riffles | Gallery forest | Rocky outcrops and sand | 287 |
| 4d | Kakada River, Kajioco stream | 05°28'06" N, 64°30'21" W | Run | Gallery and flooded forest | Sand, clay and litter | 284 |
| 4e | Kakada River, Amana stream | 05°25'04" N, 64°30'01" W | Run | Gallery and flooded forest | Sand and litter | 300 |
| 4f | Kakada River, confluence with the Madajano River | 05°11'51" N, 64°31'15" W | Run and riffles | Gallery and flooded forest | Sand and litter | 298 |
| 4g | Kakada River, main channel | 05°00'24" N, 64°38'56" W | Run and riffles | Flooded grassland and forest | Sand and litter | 311 |
| 4h | Kakada River, confluence with the Shimada River | 04°59'29" N, 64°39'08" W | Run | Gallery forest | Sand and litter | 310 |
| 5 | Caura river, port of Maripa | 07°24'50" N, 64°11'47" W | Marginal pool | Flooded grassland | Sand and clay | 31 |
| 6 | Aricagua lagoon | 07°33'40" N, 65°07'27" W | Floodplain oxbow lagoon | Flooded forest, shrubs and grassland | Sand, clay and litter | 22 |
| 7 | Paramuto lagoon | 07°32'48" N, 64°59'48" W | Floodplain oxbow lagoon | Flooded forest and shrubs | Sand and litter | 20 |

TABLE 2. Fish species richness in some basins of the Venezuelan Guyana Shield, including the areas and number of shared species with the Caura basin.

| BASINS | AREA (KM ²) | SPECIES RICHNESS | SHARED SPECIES WITH CAURA BASIN | SOURCE |
|---------------------------------|-------------------------|------------------|---------------------------------|---|
| Atabapo | 9.760 | 172 | 131 | Lasso <i>et al.</i> (2004b) |
| Caroní | 95.000 | 290 | 205 | Lasso (unpublished data) |
| Casiquiare channel ¹ | — | 452 | 229 | Winemiller <i>et al.</i> (2008) |
| Caura | 47.000 ² | 543 | — | This paper |
| Cuyuní | 50.000 ³ | 229 | 137 | Lasso <i>et al.</i> (2004a); Giraldo <i>et al.</i> (2007); Lasso <i>et al.</i> (2009) |
| Paragua | 39.605 | 150 | 120 | Lasso <i>et al.</i> (2008) |
| Suapure | 4.720 | 119 | 104 | Lasso <i>et al.</i> (2004b) |
| Ventuari | 40.000 | 470 | 249 | Montaña <i>et al.</i> (2006) |

¹ Includes some affluents from Upper Orinoco and upper rio Negro
² Area of the basin by Huber (1995)
³ 38.000 Km² correspond to Venezuela

TABLE 3. Annotated list and their respective abundances of species newly recorded in each one of the sampled sites of both sections. The abbreviations of the sites (S) are presented in the Table 1.

| TAXA | UPPER CAURA | | | | | | | | | | LOWER CAURA | | | VOUCHERS | |
|--|-------------|----|----|-----|-----|-----|-----|-----|-----|-----|-------------|------|----|----------|---|
| | S1 | S2 | S3 | S4a | S4b | S4c | S4d | S4e | S4f | S4g | S4h | S5 | S6 | | S7 |
| CHARACIFORMES | | | | | | | | | | | | | | | |
| Anostomidae | | | | | | | | | | | | | | | |
| <i>Leporinus fasciatus</i> (Bloch, 1794) | | | | | 3 | 3 | | | | | | | | | CRIEDIHG-6131 |
| <i>Leporinus friderici</i> (Bloch, 1794) | 1 | | | 1 | 2 | 36 | 18 | 4 | 9 | 37 | 1 | | | | CRIEDIHG-6004, 6027, 6112. 6116 |
| Characidae | | | | | | | | | | | | | | | |
| <i>Brycon</i> sp. | | | | | | | 1 | | | | | | | -- -- -- | |
| <i>Brycon</i> cf. <i>amazonicus</i> (Spix and Agassiz, 1829) ✓ | | | | | | | | | | | | | 1 | | CRIEDIHG-8010 |
| <i>Charax</i> sp. “cf. pauciradiatus” ✓ | | | 1 | | 1 | 20 | | 10 | | 1 | | | | | CRIEDIHG-6051, 6061, 6067, 6082, 6087, 6096, 6100, 6102, 6121, 6217 |
| <i>Hemigrammus</i> cf. <i>gracilis</i> (Lütken, 1875) ✓ | | | | | | | | | | | | 5606 | 34 | | CRIEDIHG-7796, 7809, 7828, 7891, 7924, 7934, 7942, 7978, 7998, 8017, 8025, 8032, 8033, 8045 |
| <i>Hemigrammus</i> cf. <i>ocellifer</i> (Steindachner, 1882) ✓ | | | | | | | | | | | | 385 | | | CRIEDIHG-7567, 7574, 7588. 7612, 7623, 7791, 7827, 7885 |
| <i>Hyphessobrycon sweglesi</i> (Géry, 1961) ✓ | | | | | | | | | | | | 28 | | | CRIEDIHG-7905 |
| <i>Knodus</i> cf. <i>heterestes</i> ✓ | | | | | 1 | 12 | | | | | | | | | CRIEDIHG-6325, 6337, 6350, 6355, 6358 |
| <i>Moenkhausia jamesi</i> Eigenmann, 1908 ✓ | | | | | | | | | | | | 31 | | | CRIEDIHG-7387, 7425 |
| <i>Moenkhausia megalops</i> (Eigenmann, 1907) ✓ | | | | | | | | | | | | 5 | | | CRIEDIHG-7838 |
| <i>Moenkhausia</i> sp.1 “gr. chrysargirea” ✓ | | | | | | 3 | | | | | | | | | CRIEDIHG-6329, 6361 |
| <i>Moenkhausia</i> sp.2 “gr. chrysargirea” ✓ | | | | | 9 | | | | | | | | | | CRIEDIHG-6467 |
| <i>Poptella</i> sp. ✓ | | | 1 | | 5 | 2 | | 1 | | 1 | | | | | CRIEDIHG-6095, 6099, 6101, 6115, 6252 |
| <i>Serrasalmus elongatus</i> Kner, 1858 | | 2 | | | | | | | | | | | | -- -- -- | |
| <i>Tyttobrycon xerui</i> Géry, 1973 ✓✓ | | | | | | | | | | | | 41 | | | CRIEDIHG-7919 |
| Crenuchidae | | | | | | | | | | | | | | | |
| <i>Microcharacidium eleotrioides</i> (Géry, 1960) ✓ | | | | | | | | | | | | 134 | | | CRIEDIHG-7439, 7450, 7461, 7472, 7494, 7505, 7518, 7537, 7558, 7763, 7780, 7863 |
| Curimatidae | | | | | | | | | | | | | | | |
| <i>Curimata</i> sp. ✓ | | | | | 1 | | | | | | | | | | CRIEDIHG-6277 |
| <i>Steindachnerina</i> cf. <i>argentea</i> (Gill, 1858) | | | | | 2 | | | | | | | | | | CRIEDIHG-6397 |
| Erythrinidae | | | | | | | | | | | | | | | |
| <i>Erythrinus erithrinus</i> (Bloch and Schneider, 1801) ✓ | | | | | 4 | | | | | | | | | | CRIEDIHG-6459 |
| <i>Hoplerethrinus unitaeniatus</i> (Agassiz, 1829) | | | | | | | | 1 | | | | | | | CRIEDIHG-6151 |
| Hemiodontidae | | | | | | | | | | | | | | | |
| <i>Hemiodus amazonum</i> (Humboldt, 1821) | | | | | | 12 | | | | | | | | | CRIEDIHG-6053, 6059, 6062, 6068, 6077, 6085 |
| <i>Hemiodus gracilis</i> Günther 1864 ✓ | | | | | | | | | | | | 24 | | | CRIEDIHG-7419, 7447, 7460, 7489, 7534, 7555, 7591, 7625 |
| <i>Hemiodus ternetzi</i> Myers 1927 ✓ | | | | | | | | | | | | 35 | | | CRIEDIHG-7330 |
| CLUPEIFORMES | | | | | | | | | | | | | | | |
| Engraulidae | | | | | | | | | | | | | | | |
| <i>Amazonasprattus scintilla</i> Roberts, 1984 ✓ | | | | | | | | | | | | 98 | 10 | | CRIEDIHG-7849, 7888, 8100, 8105 |
| <i>Anchoviella lepidentostole</i> (Fowler, 1911) ✓ | | | | | | | | | | | | 727 | | | CRIEDIHG-7433, 7444, 7456, 7475, 7500, 7510, 7523, 7584, 7667 |

TABLE 3. CONTINUED.

| TAXA | UPPER CAURA | | | | | | | | | | LOWER CAURA | | | VOUCHERS | |
|---|-------------|----|----|-----|-----|-----|-----|-----|-----|---|-------------|----|---------------|----------|---|
| | S1 | S2 | S3 | S4a | S4b | S4c | S4d | S4e | S4f | S4g | S4h | S5 | S6 | | S7 |
| Anchoviella manamensis Cervigón, 1982 ✓ | | | | | | | | | | | | | | | |
| GYMNOTIFORMES | | | | | | | | | | | | | | | |
| Sternopygidae | | | | | | | | | | | | | | | |
| Eigenmannia virescens (Valenciennes, 1842) | | | | 6 | | | | | | | | | | | CRIEDIHG-6195 |
| Eigenmannia humboldtii (Steindachner, 1878) ✓ | | | | | | | | | | | | 7 | | | CRIEDIHG-7377, 7402 |
| Sternopygus macrurus (Bloch and Schneider, 1801) | | | | 4 | | | | | | | | | | | CRIEDIHG-6203, 6211 |
| SILURIFORMES | | | | | | | | | | | | | | | |
| Auchenipteridae | | | | | | | | | | | | | | | |
| Auchenipterus ambyacus Fowler, 1915 | | | | | | | | | | 1 | | | | | CRIEDIHG-6110 |
| Tatia sp. ✓ | 1 | | | | | | | | | | | | | | CRIEDIHG-6255 |
| Centromochlus heckelii (De Filippi 1853) ✓ | | | | | | 1 | | | | | | | | | CRIEDIHG-6022 |
| Trachelyopterus galeatus (Linnaeus 1766) | | | | 3 | | 2 | | | | | | | | | CRIEDIHG-6017 |
| Loricariidae | | | | | | | | | | | | | | | |
| Baryancistrus sp. ✓ | | | | 1 | | | | | | | | | | | CRIEDIHG-6455 |
| Pimelodidae | | | | | | | | | | | | | | | |
| Pimelodina flavipinnis Steindachner 1877 ✓ | | | | | | | | | | 3 | | 9 | | | CRIEDIHG-6473, 6492, 6545, 6550, 6659, 6665, 6816, 6828 |
| Trichomycteridae | | | | | | | | | | | | | | | |
| Trichomycterus sp. ✓ | | | | | | | | | 1 | | | | | | CRIEDIHG-8122 |
| PERCIFORMES | | | | | | | | | | | | | | | |
| Cichlidae | | | | | | | | | | | | | | | |
| Crenicichla cf. macrophthalma Heckel 1840 ✓ | | | | | | | | | | | 2 | | | | CRIEDIHG-7989, 8024 |
| Sciaenidae | | | | | | | | | | | | | | | |
| Plagioscion cf. casattii Aguilera y Aguilera 2001 ✓ | | | | | | | | | | | 2 | | | | CRIEDIHG-6744, 6760 |
| TETRAODONTIFORMES | | | | | | | | | | | | | | | |
| Tetraodontidae | | | | | | | | | | | | | | | |
| Colomesus asellus (Müller y Troschel 1849) ✓ | | | | | | | | | | | | 1 | | | CRIEDIHG-8121 |
| Total new reports in each section ==> | | | | | | | | | | 22 | | | 18 | | |
| Total new reports in whole Basin ==> | | | | | | | | | | 11 spp. upper Caura + 18 spp. lower Caura | | | Total 29 spp. | | |
| ✓ New reports for Caura Basin | | | | | | | | | | | | | | | |
| ✓✓ New report for Orinoco Basin | | | | | | | | | | | | | | | |

TABLE 4. Some of the species of the upper Caura (absent in lower Caura) shared with other sub-basins of the Venezuelan Guayana Shield.

| SPECIES | CARONÍ RIVER | PARAGUA RIVER | CUYUNÍ RIVER | VENTUARI RIVER | CASIQUIARE CHANNEL |
|--|--------------|---------------|--------------|----------------|--------------------|
| <i>Ageneiosus inermis</i> Linnaeus, 1766 | X | X | X | X | X |
| <i>Apareiodon</i> sp. | | X | | | |
| <i>Crenicichla saxatilis</i> (Linnaeus, 1758) | X | | X | | |
| <i>Doras carinatus</i> (Linnaeus, 1766) | | X | X | | X |
| <i>Erythrinus erythrinus</i> (Bloch and Schneider, 1801) | X | X | X | X | |
| <i>Geophagus grammepareius</i> Kullander and Taphorn, 1992 | X | | | | |
| <i>Guianacara geayi</i> (Pellegrin, 1902) | X | | | | |
| <i>Guianacara stergiosi</i> López-Fernández, Taphorn and Kullander, 2006 | X | X | | | |
| <i>Hemiodus</i> cf. <i>unimaculatus</i> (Bloch, 1794) | | | X | | |
| <i>Hypopygus neblinae</i> Mago-Leccia, 1994 | | | | X | |
| <i>Jupiaba</i> cf. <i>zonata</i> (Eigenmann, 1908) | X | | | | |
| <i>Jupiaba</i> sp. | | X | | | |
| <i>Knodus</i> cf. <i>heterestes</i> (Eigenmann, 1908) | | | X | | |
| <i>Leporinus arcus</i> Eigenmann, 1912 | X | X | X | | |
| <i>Moenkhausia</i> cf. <i>miangi</i> Steindachner, 1917 | X | X | | | |
| <i>Prochilodus rubrotaeniatus</i> Jardine and Schomburgk, 1841 | X | X | X | X | X |
| TOTAL SHARED SPECIES: | 10 | 9 | 8 | 4 | 3 |

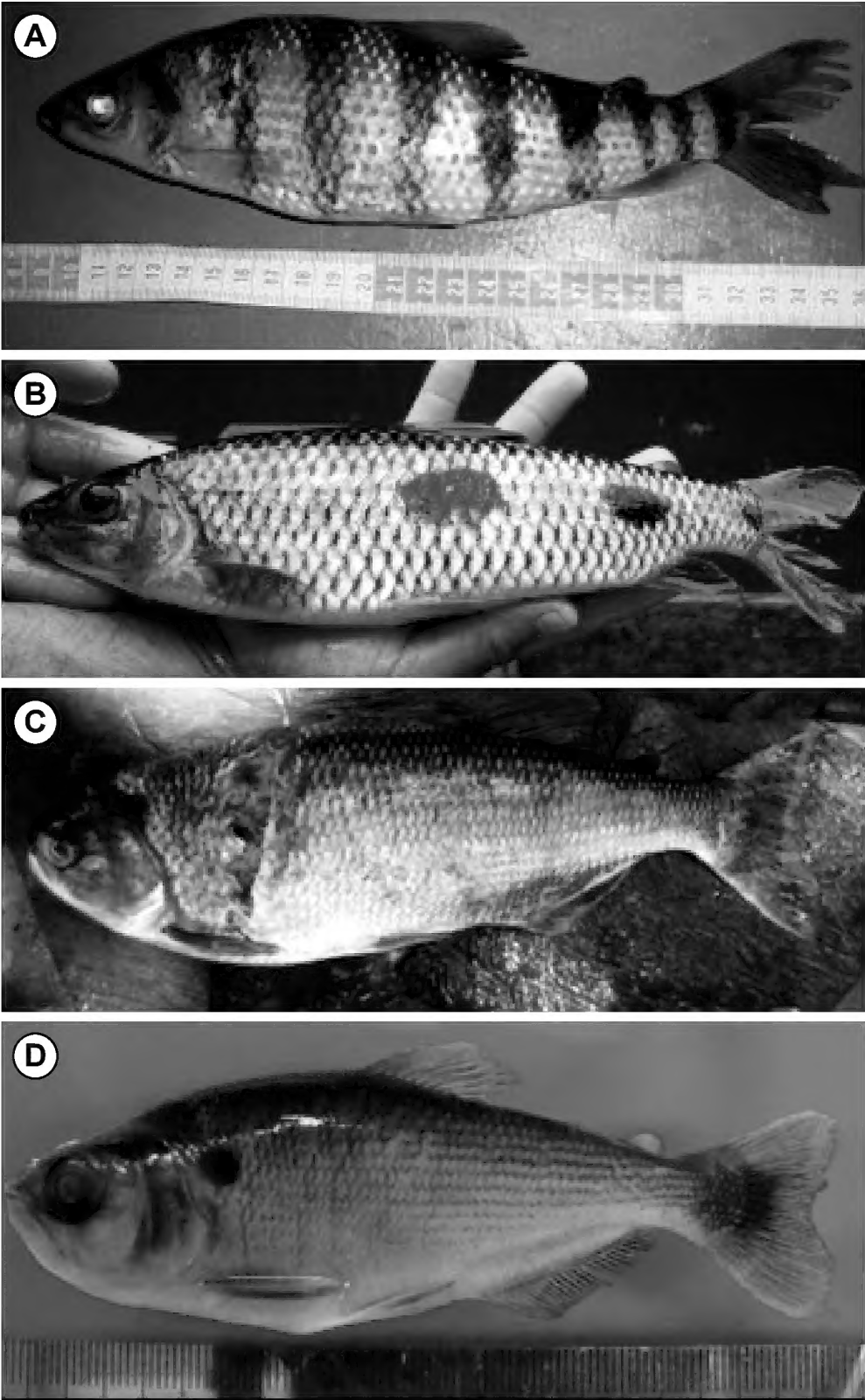


FIGURE 2. A. *Leporinus fasciatus* CRIEDIHG 6131, Ka’kada river: site 4b y 4c, 19-iv-2009; B. *Leporinus* gr. *friderici* CRIEDIHG 6027, Ka’kada river: site 4c, 23-v-2008; C. *Brycon* sp. (not preserved), Ka’kada river: site 4d, ?-iii-2009; D. *Brycon amazonicus* CRIEDIHG 8010, Paramuto Lagoon, 25-ix-2009.

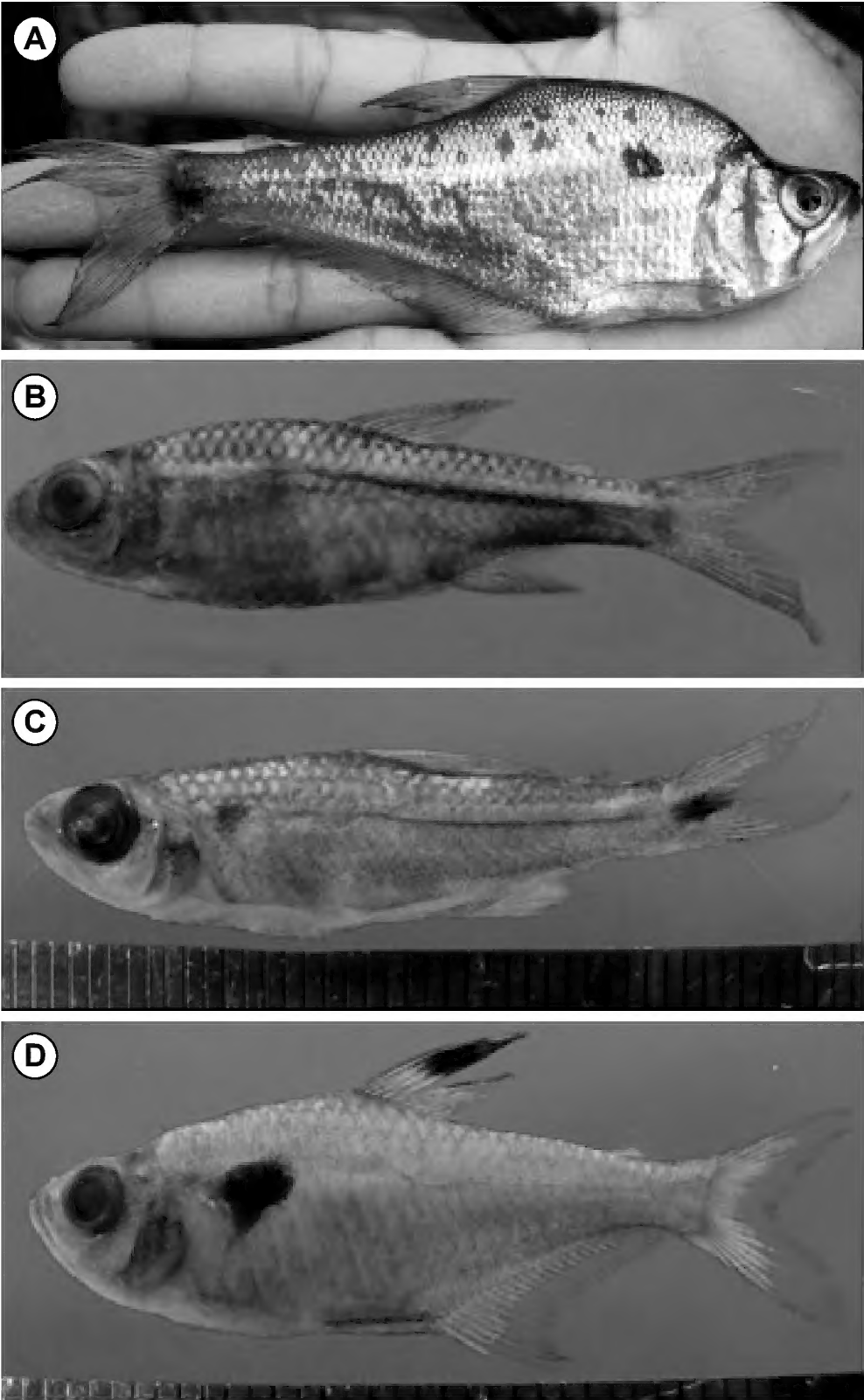


FIGURE 3. A. *Charax* sp. “cf. *pauciradiatus*” CRIEDIHG 6159, Kushime river, 21-v-2008; B. *Hemigrammus* cf. *gracilis* CRIEDIHG 7796, Aricagua Lagoon, 05-vii-2009. C. *Hemigrammus* cf. *ocellifer* CRIEDIHG 7588, Aricagua Lagoon, 27-x-2008; D. *Hyphessobrycon sweglesi* CRIEDIHG 7905, Paramuto Lagoon, 09-vii-2009;

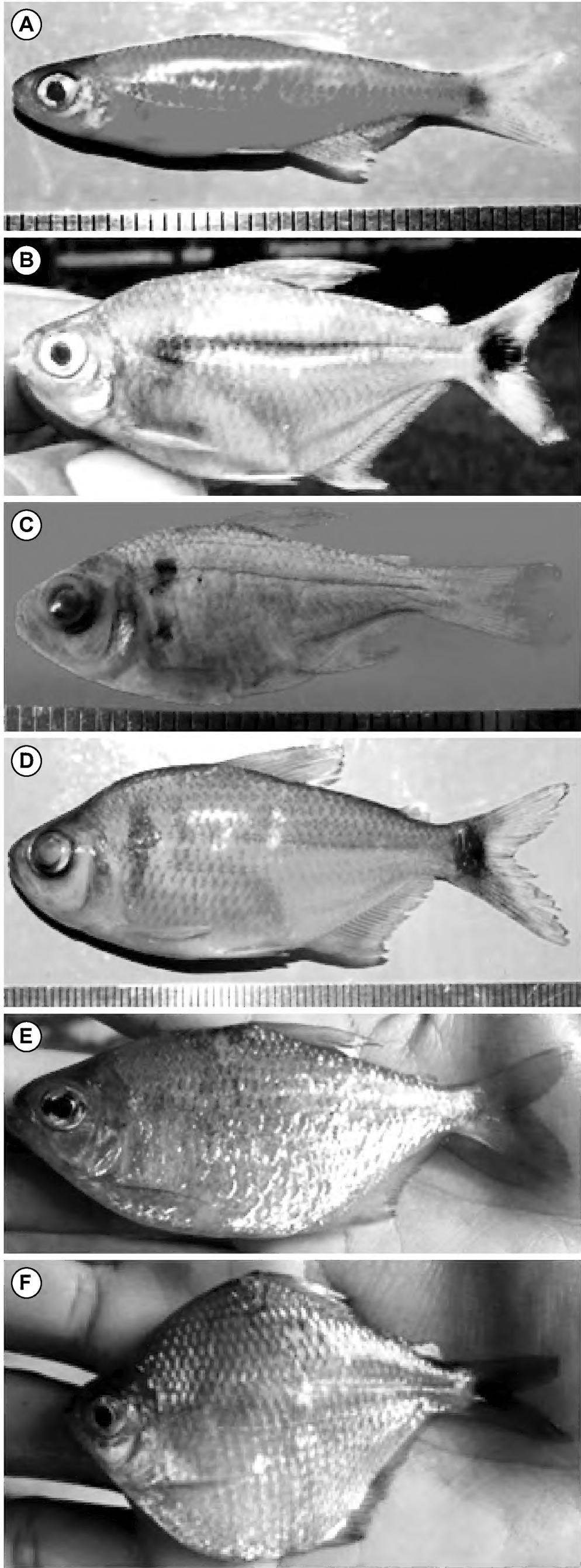


FIGURE 4. A. *Knodus* cf. *heterestes* CRIEDIHG 6358, Ka'kada river: site 4c, 17-xi-2008; B. *Moenkhausia jamesi* CRIEDIHG 7425, Aricagua Lagoon, 13-ii-2008; C. *Moenkhausia megalops* CRIEDIHG 7838, Aricagua Lagoon, 06-vii-2009; D. *Moenkhausia* sp.1 "gr. *chrysargirea*" CRIEDIHG 6361, Ka'kada river: site 4c, 17-xi-2008; E. *Moenkhausia* sp.2 "gr. *chrysargirea*" CRIEDIHG 6467, Ka'kada river: site 4b, 23-iv-2009; F. *Poptella* sp. CRIEDIHG 6115, Ka'kada river: site 4g, 19-xi-2008.

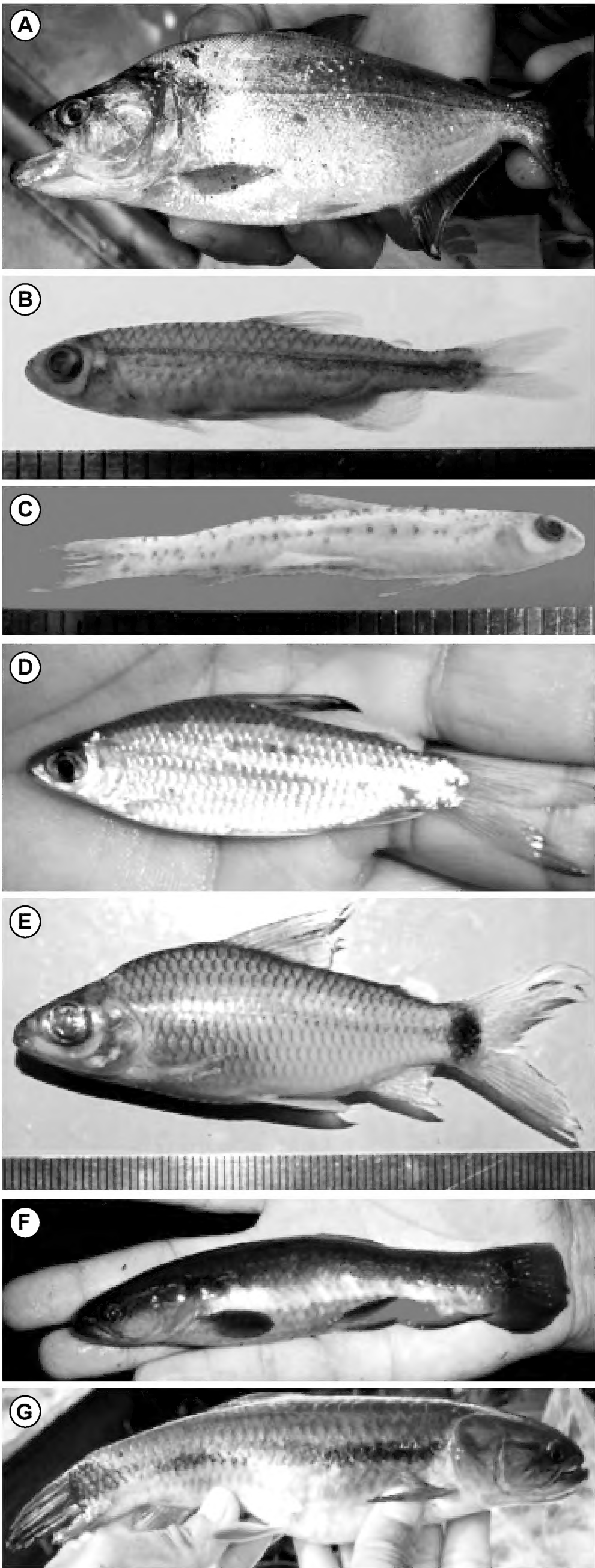


FIGURE 5. A. *Serrasalmus elongatus* (not preserved), confluence of the Erebató River with the Caura, 20-v-2008; B. *Tyttobrycon xerui* CRIEDIHG 7919, Paramuto Lagoon, 09-vii-2009; C. *Microcharacidium eleotrioides* CRIEDIHG 7461, Aricagua Lagoon, 13-ii-2008; D. *Curimata* sp. CRIEDIHG 6277, Ka'kada river: site 4c, 01-x-2008; E. *Steindachnerina* cf. *argentea* CRIEDIHG 6397, Ka'kada river: site 4c, 18-iv-2009; F. *Erythrinus erythrinus* CRIEDIHG 6459, Ka'kada river: site 4b, 23-iv-2009; G. *Hoplerthrinus unitaeniatus* CRIEDIHG 6151, Ka'kada river: site 4e, 21-iv-2009.

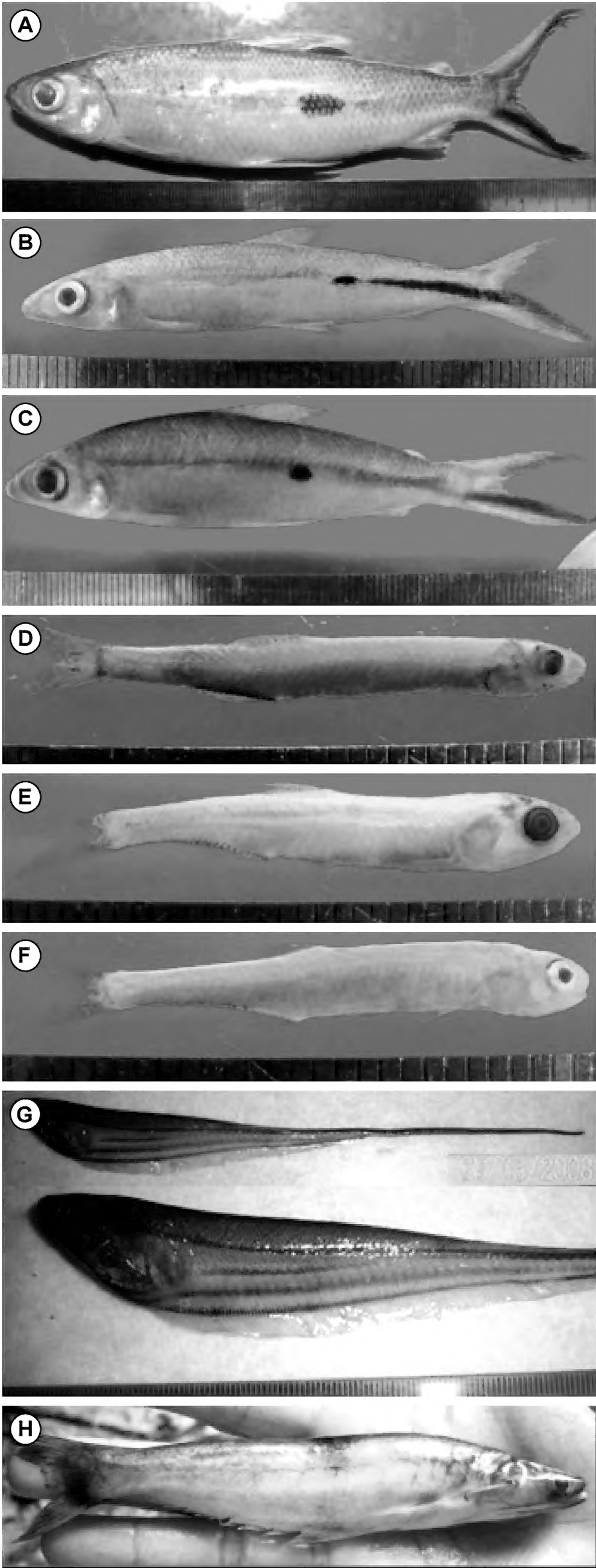


FIGURE 6. A. *Hemiodus amazonum* CRIEDIHG 6085, Ka'kada river: site 4c, 15-xi-2008; B. *Hemiodus gracilis* CRIEDIHG 7591, Aricagua Lagoon, 27-X-2008; C. *Hemiodus ternetzi* CRIEDIHG 7330, Paramuto Lagoon, 10-ii-2008; D. *Amazonsprattus scintilla* CRIEDIHG 8105, Paramuto Lagoon, 28-ix-2009; E. *Anchoviella lepidentostole* CRIEDIHG 7500, Aricagua Lagoon, 13-ii-2008; F. *Anchoviella manamensis* CRIEDIHG 8062, Paramuto Lagoon, 28-ix-2009; G. *Eigenmannia virescens* CRIEDIHG 6195, Ka'kada river: site 4b, 23-v-2008; H. *P. Auchenipterus ambyacus* CRIEDIHG 6110, Ka'kada river: site 4g, 19-xi-2008.

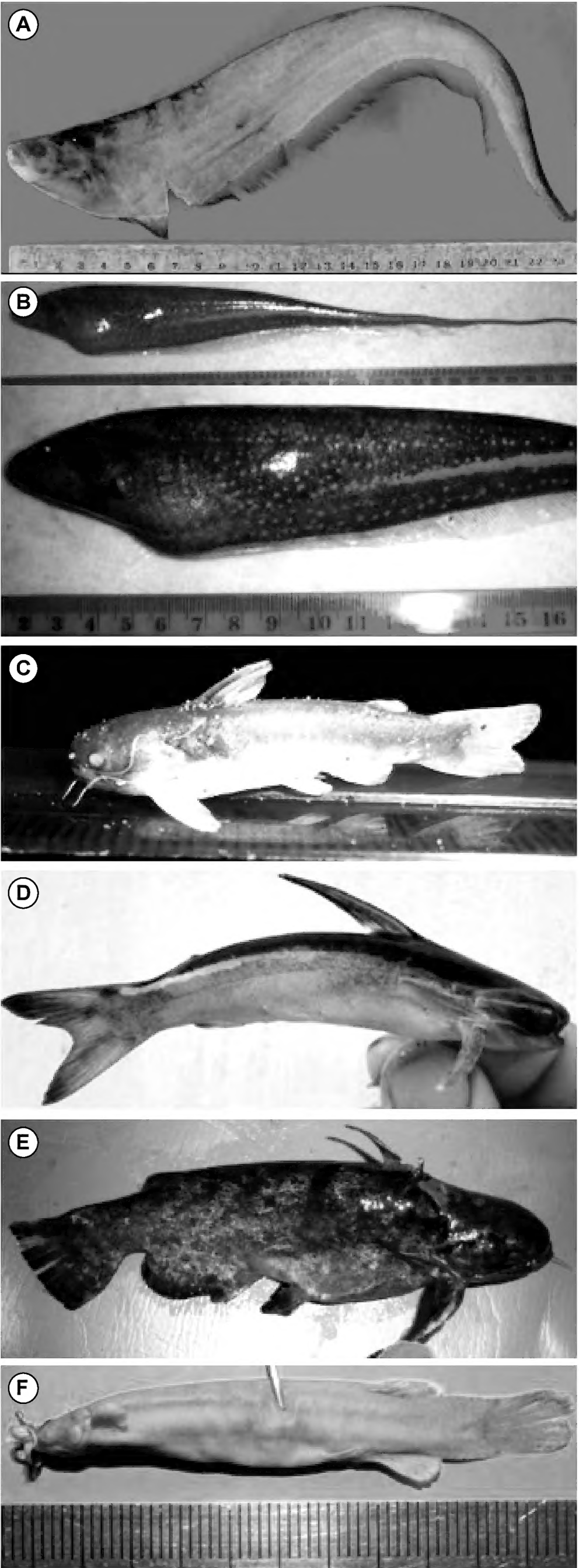


FIGURE 7. A. *Eigenmannia humboldtii* CRIEDIHG 7377, Aricagua Lagoon, 13-ii-2008; B. *Sternopygus macrurus* CRIEDIHG 6211, Ka'kada river: site 4b, 23-v-2008; C. *Tatia* sp. CRIEDIHG 6255, Ka'kada river: site 4a, 23-v-2008 and D. *Centromochlus heckelii* CRIEDIHG 6022, Ka'kada river: site 4c, 22-v-2008; E. *Trachelyopterus galeatus* CRIEDIHG 6020, Ka'kada river: site 4c, 22-v-2008; F. *Trichomycterus* sp. CRIEDIHG 8121, Ka'kada river: site 4f, 14-iii-2009.

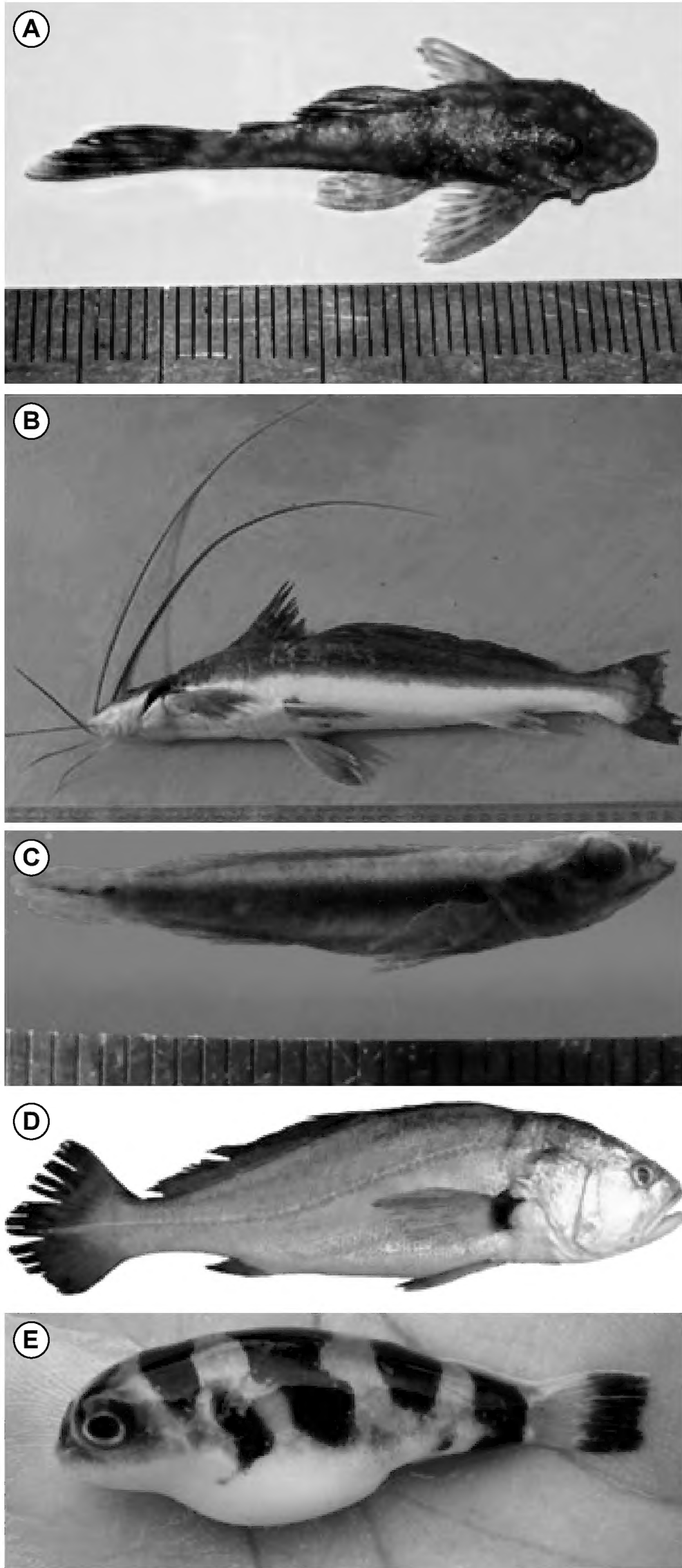


FIGURE 8. A. *Baryancistrus* sp. CRIEDIHG 6455, Ka'kada river: site 4b, 25-iv-2009; B. *Pimelodina flavipinnis* CRIEDIHG 6492, Paramuto Lagoon, 09-ii-2008; C. *Crenicichla* cf. *macrophthalma* CRIEDIHG 7989, Aricagua Lagoon, 24-ix-2009; D. *Plagioscion* cf. *casattii* CRIEDIHG 6760, Aricagua Lagoon, 13-ii-2008; E. *Colomesus asellus* CRIEDIHG 8121, Port of Maripa in lower Caura: site 5, 06-x-2008.

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